IMPROVISING VEHICLE MOBILITY FOR ROAD SAFETY THROUGH MACHINE LEARNING APPROACHES

A SYNOPSIS

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1. INTRODUCTION

In today's world, road and transport have become an integral partof every human being. Everybody is a road user in one shape or the other. The present transport system has minimized the distances but it has on the other hand increased the life risk. Every year road accidents result in the loss of lakhs of lives and serious injuries to crores of people.

Driving is an obligatory exercise for most people. People use their vehicles to pass from one region to different place. Nowadays, the number of accidents is so excessive and uncertain. Accidents occur each and every time, in all places and for all reasons, resulting in the worst damage, serious harm, and death.

In India itself, about eighty thousand people are killed in road crashes every year which is thirteen percent of the total fatality all over the world Man behind the wheel plays an important role in most of the crashes. In most of the cases accident occurs either due to carelessness or due to lack of road safety awarenessof the road user.

India is a developing country, we are focusing on our infrastructure development and digitalizing the country with the help of technology. Related to that, India is also working on the automobile industry to build a successful autonomous vehicle which drives on its own without the help of any human.

Now a days some of the cars are developed with an advanced detection of accident system (ADAS) in which, if the vehicle finds any vehicle or pedestrian in front of it, the alert signal is given to the driver.This is not much efficient and causes accidents in some cases. This ADAS is not able to work properly because of bad weather and low light density conditions and leads to obstacle collisions. Figure 1 and Figure 2 gives us a pictogram of the number of road accidents and the causes for road accidents.

This thesis aims to provide a road safety system for road users to encourage safer road use among current and prospective road users and reduce the number of people killed and injured on the roads every year

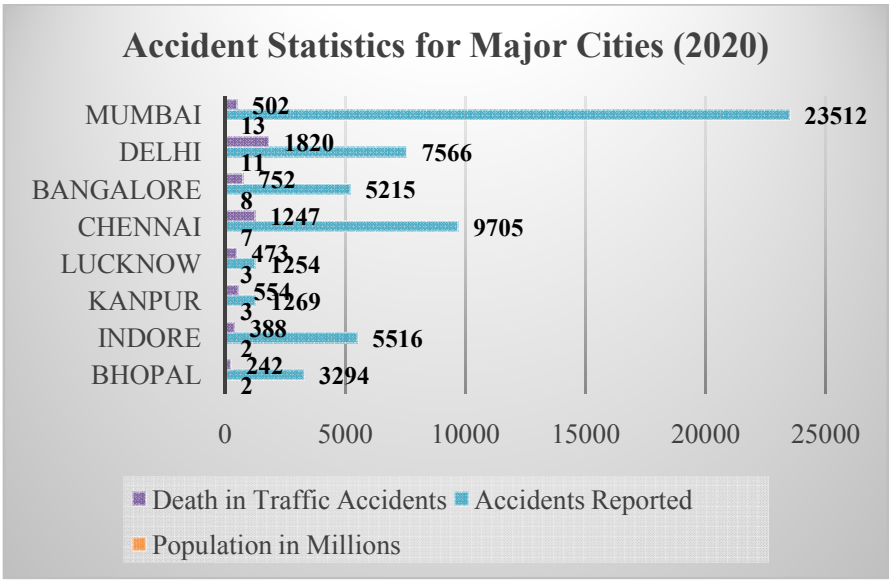

Figure 1: Accident Statistics for Major Cities (2020)

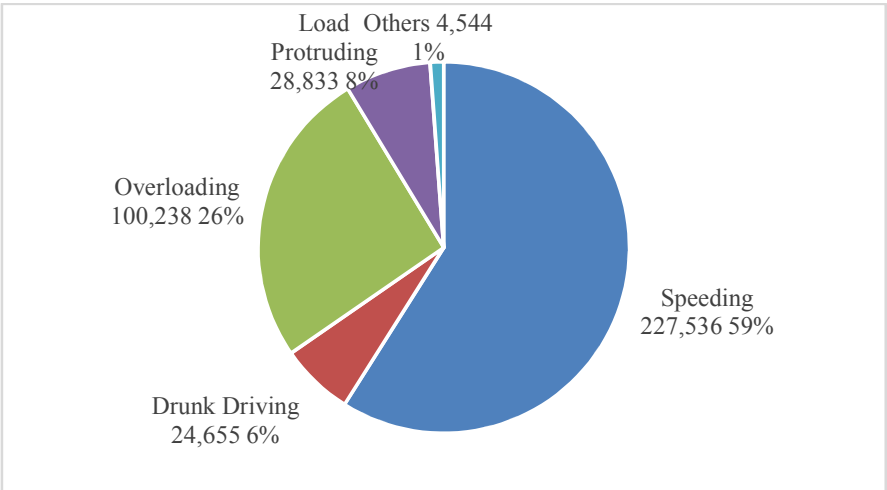

Figure 2: Causes of Road Accidents

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Through the use of sample data or prior knowledge, machine learning allows computers to optimise performance criteria. We have a model that has been developed up to a certain point, and learning is the application of a computer program to optimise the model's parameters using training data or prior knowledge. The model may be descriptive to learn from the data or predictive to make future predictions.

How to build computer programmes that automatically get better with experience is a topic of research in the field of machine learning.

Definition of learning: A computer program is said to learn from experience E concerning some class of tasks T and performance measure P, if its performance at tasks T, as measured by P, improves with experience E.

The construction of collision prediction models (CPM) and the examination of factors influencing accident incidence is made possible by road safety modeling, which is a useful technique for encouraging safe mobility. Although the limits of this method are acknowledged, statistical approaches have typically been utilized in this modeling. This presents an opportunity to investigate alternatives, such as the use of machine learning (ML) techniques.

2. LITERATURE REVIEW

This section will supply an overview of the literature associated to integrating Autonomous Vehicle (AV). Recent analysis on AV modeling and have an effect on predictions have grew to become extra and greater mature. From the time when motors in the DARPA venture have been trying to keep away from limitations till now, few states in the U.S. have issued permission for check using of self reliant vehicles; however the advantages of AVs have pushed human beings to pay extra attention.

David Elliott [1] (2019) introduced lookup that simulated the overall performance of shared independent cars (SAV) in an agent-based mannequin with a dynamic ridesharing method. Their effects point out that SAVs may want to minimize time out delays, time out charges and car miles traveled (VMT).

Soysal [2] (2019) introduced an SAV adoption mannequin based totally on the mentioned preference survey in Australia. Their outcomes exhibit that SAVs may additionally be extra captivating to younger globetrotter and that their acceptance is very intuitive to provider attributes.However, what these utility will seem to be like is very uncertain to travelers, mainly if they haven’t even skilled AVs.

Oregon et.al. [3] (2019) proposed a logistic regression mannequin to estimate the pastime variables to SAVs from a cited adaptation experiment. They located that vacationers are now not very touchy to these variables, which point out that the contemporary market is no longer paying interest to SAVs. Even although this find out about targeted on estimating the market response of self sustaining taxis in Belgium, humans appeared to now not like the thinking of the usage of SAVs, which can also additionally manifest in U.S. Besides, SAVs are greater like a public transit system; it will want a giant quantity of preliminary funding from the government. The deployment for SAVs will actually require greater time than AVs.

Although a lot of lookup has addressed the goal of AVs, very few have been examined the integration of AVs into a site visitors planning model. In 2015, Levin et al. first proposed to consider the have an impact on of AV possession on trip, mode and route choice in a basic four-step planning mannequin in Austin, Texas. They made assumptions that AVs are going to show up in 20 to 30 years with growing community ability and self-parking ability. They divided vehicle possession via special price of time (VOT) and introduced a Boolean variable to decide whether or not this type makes use of AVs totally or not at all. Though the trouble of now not attaining convergence in visitors task may additionally occur with multi-class formulation, they are nevertheless capable to produce practical effects considering this issue is frequent inside all fashions that use multi-class VOT. However, one main challenge of integrating AVs into a cutting-edge mannequin is how to determine the penetration rate overall and with the aid of special businesses of people. Levin's way of reaching that used to be to divide them into distinct profits groups. The downside of this is that no longer everybody in a high-income team will personal an AV and conversely in a low-income group.

Andrew Kun et. al. [4] (2016) brought a visitors demand mannequin for the U.S. and Germany to mannequin the affect of AVs. This mannequin has a comparable process as a fourstep model, barring it solely runs the first three steps. They observe an AV diffusion model as an exterior mannequin in order to mannequin extraordinary eventualities with distinctive AV proportions. The core mannequin makes use of NHTS information to habits the outing era and mode desire part together, accompanied by means of a outing distribution procedure. Their consequences

confirmed that AVs both in Germany and U.S. will possibly expand the VMT and the travelers' journey mode will likely shift from transit to cars. This lookup used to be performed on AV influence analysis and a assessment between Germany and U.S. with the aid of the use of a very simplified four-step model. This fashion will additionally emerge as extra awesome with the AV penetration rate increasing. It substantially decreased the computational work on calculating user equilibrium by way of ignoring the visitors task step. However, this makes them lose the ability to seem into the conceivable have an effect on of AVs in the site visitors network.

Since the agent-based mannequin (ABM) is now very famous in the transportation field, a few research are additionally searching at the influence of AVs. ChangxiYou et. al. [5] (2018) proposed an prolonged ABM to simulate the AV gadget with three distinct time-scale simulation levels. They particularly simulated the AV machine on non permanent and midterm tiers to seize its affect on journey behavior. The major distinction between a four-step mannequin and ABM is that one is by and large served as a long-term planning model and the different one is a simulation-based mannequin that in the main serves to see momentary or mid-term impact. The benefit of the use of ABM is that ABM can accumulate individual travel information, which lets in researchers to do extra individual-level research, such as common ready time.

However, ABM has risks in contrast to the ordinary four-step model. First, it requires extra computational time than the four-step mannequin due to the fact of individual-level computation. Second, it is higher to use it with the already existing travel mode given that it requires extra traits of every journey mode. AVs are nonetheless in the trying out stage and their behaviors are in the main predictions. With greater envisioned inputs, the uncertainty of the effects may additionally come to be increased than the regular four-step model. After all, the major purpose of assessing AVs' affect is to see the approximation traits of how AV conduct modifications will affect the site visitors network. This thesis selected to combine AVs' conduct in MSTM to higher current the affect of AVs with fewer required resources.

AVs will impact the mobility of traveling. Jun Li et. al.[6] (2018) proposed that AVs will perhaps enhance the mobility for these who couldn't drive, such as individuals too younger or too old. They measured this hole by way of producing

totally new trips for these groups. The learn about tried to categorize the have an impact on of AVs on travel demand into exceptional age ranges. This is a real looking assumption; in addition, other assumptions may want to be used in identifying the AVs influence, such as categorizing them into extraordinary earnings companies or special regions. According to their results, around 4.14% new journeys had been generated with the aid of AVs over all age companies and this did no longer consider the journeys shift from different modes.

Besides the enchancment of mobility with AV deployment, the gain of enhancing a driver's person ride may additionally additionally make bigger their willingness to trave Kalpana et. al. [7] (2016) proposed an perception that improving consumer trip with AVs may make AV proprietors journey extra than they do now. They listing previous lookup about negative affects of driving, such as intellectual stress whilst riding in city areas (Automotive News, 2013) and bodily injury like muscle cramps or lower back pain (Safety Services Company, 2009). According to the AV definition from NHTSA, a level three or degree 4 automation may additionally drastically limit the duty for drivers. This research, performed by using Broggie et. al. [8] (2017), advised that AVs will significantly decrease the stress that drivers presently experience.

Benefiting from automation, AVs have various elements that behave otherwise than traditional vehicles. Kanwaldeep Kaur and Giselle Rampersad [9] (2018) cautioned that AVs may want to enable motorists to relaxation and work whilst driving, decrease intersection stops and slim lanes, and find parking with the aid of itself. These advantages should probably limit driver stress, amplify road capacity and decrease parking expenses due to extra environment friendly parking.

XinXu et al [10] (2018) used a discrete tournament simulation (DES) strategy to evaluate the have an effect on of SAVs on city parking. They used three unique parking fee scenarios to look at the tradeoffs between parking fees, VMT technology and common waiting time. Their consequences exhibit that a 5% penetration price of SAV will limit approximately 4.5% of parking land use. In addition, the parking demand would additionally be influenced by road congestion and common ready time, which can also end result in parking shifts to adjacent journey evaluation zones

(TAZs), counseled that AVs might have specific behaviors than common vehicles, such as self-parking. They generated additional journeys in their mannequin to assign AVs to park in the nearest house outdoor of the center area.

Keshav Bimbraw [11] (2015) proposed a capability based totally on the traditional Greenshield's speed-density relationship. They additionally assumed the jam density to be a feature of the proportion of AVs on the avenue due to the fact AVs commonly will require much less car-following distance. Leen and Heffernan [12] (2002) accompanied the characteristic of ability associated to headway to determine the potential on the avenue with exclusive proportions of AVs. This approach was first introduced a conceptual mannequin to mirror the influence of headway in a Q-V model. Since the AVs will doubtlessly limit the carfollowing distance, distinctive proportions of AVs on the street will have a different average headway, which capability this headway Q-V mannequin ought to follow to an AV scenario's avenue potential estimation. borrowed a car-following model from Najbin Momin and Patil [13] (2017) to predict the protected car-following distance as a feature of response time.

RaivoSel et. al. [14] (2018) proposed an extension model of the family activity pattern hassle (HAPP) model. Their effects exhibit that the deployment of AVs will provide a huge vary of things to do to be carried out in-home, out-of-home and potentially in-vehicle. Gwilliam (1997) stated a conceptual framework that yields important insights into the nature of journey time (TT) savings. He stated that cost of time (VOT) savings ought to be associated to the price of exercise with which it is associated; this could apply to AVs, in that distinctive journey cause may want to have special in-vehicle time reduction.

Ulmer [15] (2002) advocated creating comparable insurance policies to these of conventional vehicles, such as excessive occupancy (HOV) automobile lanes and toll lanes, which enable jurisdictions to devote for exceptional use.

3. OBJECTIVES

In essence, the thesis studies the application and comparison of various proposed algorithms for solving some of the major issues in road accidents. The objectives of the thesis are as follows.

- To create an road traffic analysis system to monitor the congestion on the road and to improve the mobility of the vehicles
- To monitor the health conditions of the passenger and alert the situation
- To avoid collision during the travel and to make the vehicle to reach the destination

4. RESEARCH PROBLEM

There are many inventions are made in automobile industries to design and build safety measures for automobiles, but traffic accidents are unavoidable. This work involves in predicting a model that will be useful to prevent accidents and to develop safety measures. Road accident is most unwanted thing to happen to a road user, though they happen quite often. The most unfortunate thing is that we don't learn from our mistakes on road.In case of semi automated vehicle the driver has to be monitored if he is driving under the influence of drugs, if so the vehicle must not start and must give a warning alarm. It is difficult to drive in a congested traffic area we need to design a system that understand the traffic congestion and move the vehicle from source to destination without any collision

5. ORGANIZATION OF THESIS

This section explains about chapter 1 explains about an detailed background concept of Road Safety, various types and Machine Learning algorithms related to road safety. chapter2describesthe literature survey. In chapter 3 to 5, various algorithm and proposed models in detail. The results and discussions for the proposed algorithms, namely Machine Learning Random Sampling of Observed Data are described in the respective chapters. The thesis ends with the conclusion.

Chapter 1: Introduction,analyze the important aspects like architectures in the design of machine learning importance of road safety and the different machine

learning algorithms that is related to road safety.The outlook of thesis is summarized in this section. The objectives of thesis are discussedin this chapter.

Chapter 2: In this chapter the detailed summary of Literature surveyThe research gapwas identified through this survey. The comparison study among the various algorithmsthat supports road safety also done.ThisLiterature survey gives clarity to develop new algorithms to fulfill the research gap.

Chapter 3: This chapter, proposes an SARSA algorithm over the existing Q Learning algorithm and compares the Autonomous car with the Manual car in three different scenarios namely, The diagram of the Comparison between the Speed and density of the Vehiclesis shown in Figure 3. The proposed SARSA Reinforcement algorithm helps us to identify the speed of the vehicle is decreasing as the density of the vehicles increase on the road.

$$Q(s_t , a_t) = Q(s_t , a_t) + \alpha (r_{t+1} + \gamma Q(s_{t+1} , a_{t+1}) - Q(s_t , a_t))$$

s_t– Current state of the agent
a_t – Current Action Picked according to some policy
s_{t+1} - Next State
a_{t+1} - Next best action
r_{t+1} – Current Reward
γ – Discounting Factor for future reward
α – Step Length

The diagram of Comparison between the Speed and Flow rate of the Vehicles is shown in Figure 4.The proposed SARSA Reinforcement algorithm helps us to identify the speed of the vehicle is gradually increasing and then decreasing based on the flow rate of the vehicles on the road The diagram of Comparison between the Flow rate and density of the Vehicles is shown in Figure 5. The proposed SARSA Reinforcement algorithm helps us to identify the flow rate of the vehicle is gradually increasing and then decreasing based on the density of the vehicles on the road

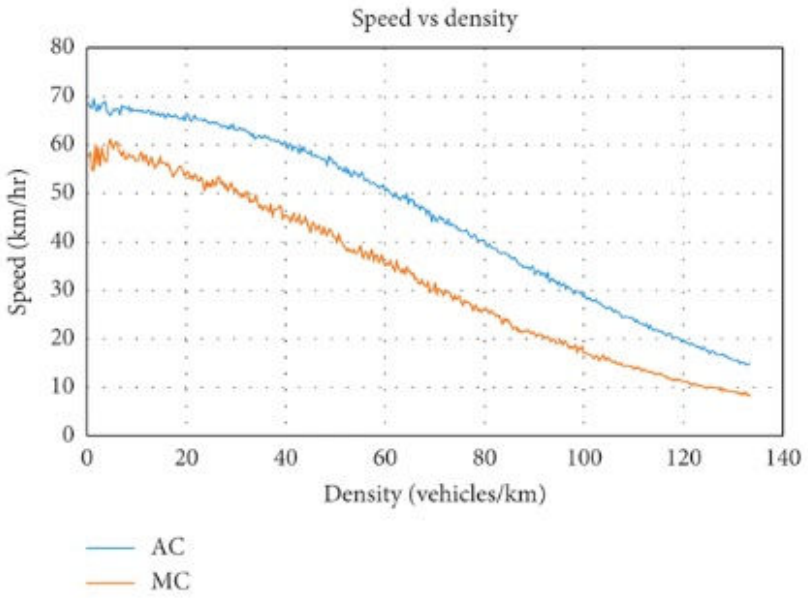


Figure 3: Comparison between the Speed and density of the Vehicles

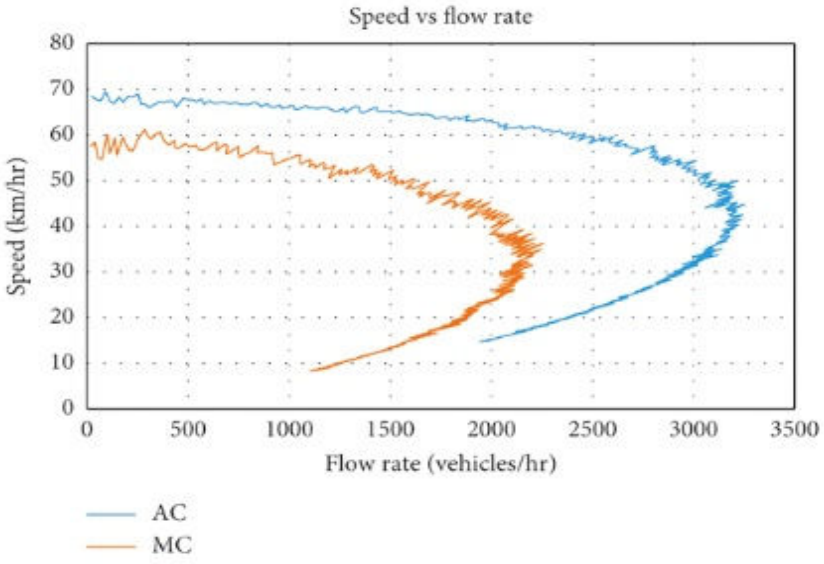


Figure 4: Comparison between the Speed and Flow rate of the Vehicles

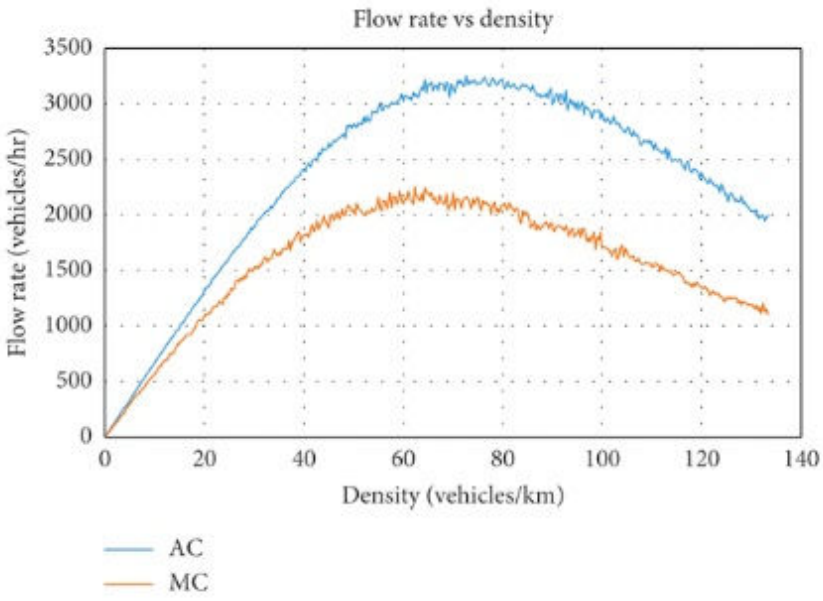


Figure 5: Comparison between the Flow rate and density of the Vehicles

Chapter 4: In this chapter, we have discussed about the design of an IoT device that analyze the environment inside the vehicle about intimating the situation to the related person to the passenger in case of emergency. We have used the sensors like SPO2, GSM Module, Adrino UNO to integrate the components and analyze the data. We have taken in to consideration the following parameters like, Heartbeat, Temperature, Pressure, Alcohol Consumption and Action of the body. The sensors that is inbuilt with the system or the prototype for sensing the activity of the person inside the vehicle is done with the help of MAX30100 sensor and it will be checked simultainously with the recorded data if there is any major change in the reading then the system will put up a alarm indicating the abnormailty. We have included the Cross validation process in finding and segregating the data that is received.

Cross Validation

- The data that are collected are standardized with the following equation

$$Y = \frac{V - Vmin}{Vmax - Vmin}$$

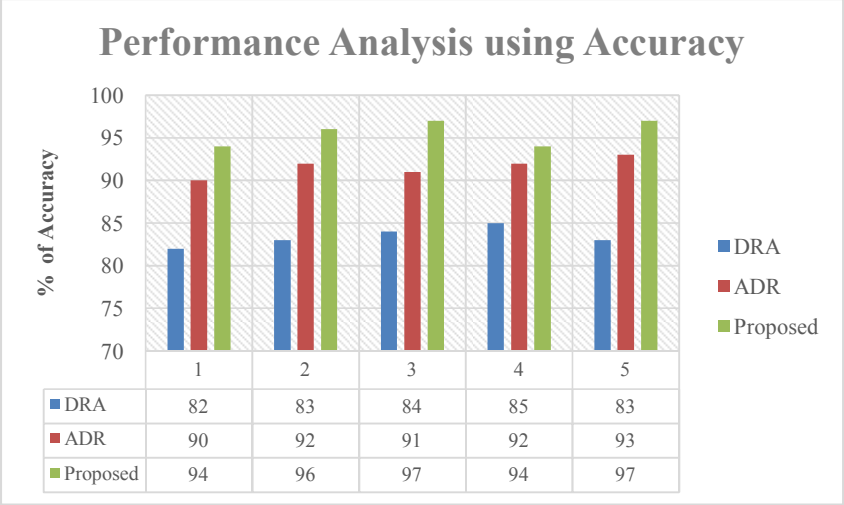
Where

Y – standardized Value

V – is the output from the sensor

V_{min}, V_{max} – minimum and maximum amplitude measured using sensor

The diagram of Graph that represents the percentage of accuracy is shown in Figure 6.The graph that represents the percentage of accuracy that has increased by the proposed system than the older algorithms.The sensors that is inbuilt with the system or the prototype for sensing the activity of the person inside the vehicle is done with the help of MAX30100, SPO2,Temperature, Physchometric sensors and if there is any emergency situations then the information is informed to the related person to the passenger with the help of the GSM module.



	1	2	3	4	5
DRA	82	83	84	85	83
ADR	90	92	91	92	93
Proposed	94	96	97	94	97

Figure 6: Graph that represents the percentage of accuracy

Chapter 5: This chapter briefly talks about the third objective outlined the model algorithm for analyzing the traffic and move the vehicle without any collision. In this work we are discussing about the SLAM – DATMO method of analyzing the environment, this helps is analyzing the environment when the vehicle is on the move. We have discussed about the Machine Learning Random Sampling of Observed Data (Ml-RMSAC) and how the algorithm works.

- *To find the tracks with the associated features of RANSAC*
- $n_{hyp} = N$
- *for i = 0 to* n_{hyp}*do*
    I. *Randomly select estimate and observation matches*
    II. *Generate hypothesis*
    III. *Only update states using EKF*
    IV. *Predict all measurements*
    V. *Compute the hypothesis set C*
    VI. *If new hypothesis has larger consensus set the previous hypothesis* (C_h>*Co) then store current hypothesis*

The diagram of Graph shows the time taken to predict the object by different algorithms and the proposed algorithm is shown in Figure 7.We have compared three different alogithms UKF, MSAC and Ml-SAC and displayed the time taken to identify and analyze the object which is in front of the vehicle and take action accordingly, the proposed algorithm analyze the obstacle well in advance that the time taken by the older algorithms both in normal wether condition and in rainy condition.

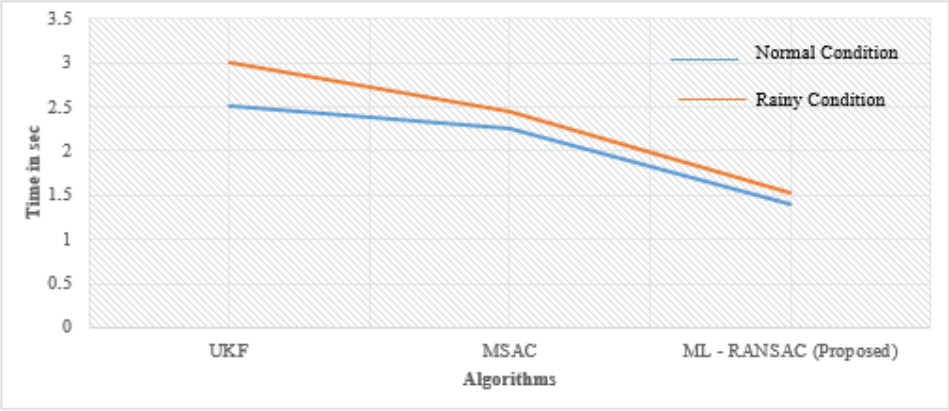


Figure 7: Graph shows the time taken to predict the object by different algorithms and the proposed algorithm

Chapter 6: This chapter proposes Conclusion and future work of the research work. The different intelligent techniques for resource allocation are compared. The advantages ofeach technique also derived here. The future scope also spelt out in this chapter.

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